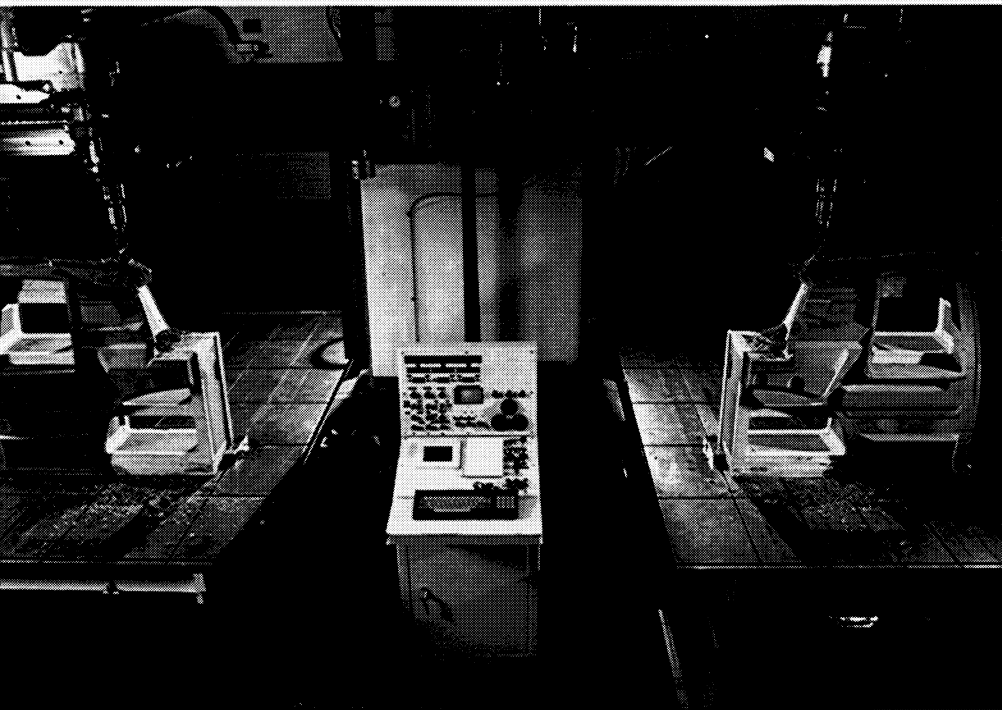


# The Space Block

*Among a sampling of spinoffs that contribute to industrial productivity is a new line of materials offering cost and efficiency advantages in master modeling*



At left is a numerically controlled Duplex Milling Machine invented by Visioneering, a Fraser, Michigan modeling firm. Computer-guided by taped instructions, it cuts die models from boards made of a plastic material derived from a substance originally developed for modeling Space Shuttle protective tiles. At right, a Visioneering engineer is using a coordinate measuring machine to check tolerances of the auto hood model pictured, which was made from the spinoff material. Developed by Ren Plastics, East Lansing, Michigan, the new epoxy resins are attracting broad interest as a replacement for traditional materials used in modeling auto, aerospace or other parts.

**T**o protect it from the searing heat of atmospheric re-entry, the Space Shuttle Orbiter is covered by more than 30,000 thermal tiles that can withstand extreme temperatures. To do this important job, the tiles must fit perfectly, thus the Shuttle prime contractor—Rockwell International—is allowed virtually no deviation from design specifications. The tiles are cut precisely to the design shape by numerically-controlled (NC) machines guided by instructions digitally recorded on tape. Since no two tiles are exactly alike, that means a separate computer program for

cutting each tile, and every program must be tested for accuracy, because even a tiny error by the programmer would result in an unacceptable finished tile.

To test the machines' accuracy, Rockwell makes master models of the tiles and compares the model dimensions with specifications. Since it would have been prohibitively expensive to make models of the actual material—a special form of silica—Rockwell originally selected polyurethane foam. But NASA, the Air Force and the Occupational Safety and Health Administration ruled out that material; when

machined, the urethane emitted hazardous fumes and dust that could cause an explosion in the presence of an electrical spark. So Rockwell began an extensive search for a machinable, stable, fireproof material free of dust hazards. Twenty-seven companies contacted were unable to meet specifications with existing materials or were unwilling to attempt to formulate an acceptable material. One company—Ren Plastics, CIBA-GEIGY Corporation, East Lansing, Michigan—agreed to make the research and development investment needed to create a new material for the master models.

The result was the "Space Block," technically known as the TDT-177-51 Ren Shape™ epoxy model block, a two-foot by two-foot by five-inch plastic block from which master models of the Shuttle tiles are cut by NC machines. The Space Block is made of epoxy resin with low viscosity and slow curing time, enabling the large block to cure uniformly without cracking. The block is filled with very small, lightweight glass globules, or "microspheres," that reduce its density to the required level. It is less porous than polyurethane, thus has a better surface for machining, and it is less prone to swelling or shrinkage due to fluctuations of temperature and humidity.

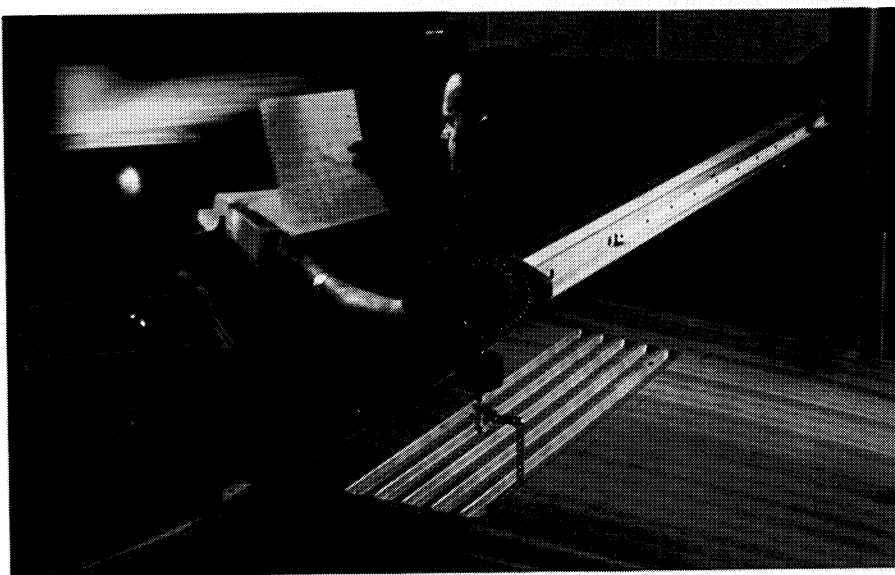
The Space Block proved to be the answer to Rockwell's needs. It has allowed Rockwell to machine tiles to very close tolerances and reduce the time needed to make an average tile. Where initially the company was able to make only a small percentage of the tiles by NC machining—the rest being made manually—it was able to use NC cutting for more than two thirds of the tiles for the newest orbiter, *Discovery*.

Ren Plastics' willingness to undertake the complicated task of developing the Space Block is paying off in a new line of Ren Shape epoxy blocks and boards designed to replace wood, urethane and other traditional materials in commercial master modeling applications. NC programs can be checked easily and at low cost with these materials, and since they can be shaped by sawing, sanding and carving as well as machining, their use is not confined to NC operations. Companies in a number of industries are looking at the Ren Shape line and Ren Plastics expects wide acceptance of its space derived materials.

An example of a Ren Shape materials user enthusiastic about them is Visioneering, Fraser, Michigan, an established company that has produced models for all U.S. auto makers, most European car makers and a number of U.S. aerospace companies. Visioneering now makes extensive use of NC machining, where formerly all of its models were hand-made of laminated Cativo wood and checked from drawings. Because inspections were

time-consuming, they were done infrequently, giving rise to the possibility of human error. With NC machining and Ren Shape materials, tolerance requirements can be more carefully observed.

But, in the view of Visioneering's vice president Tom Vertin Jr., the big attraction of the Ren Shape material is its dimensional stability. Any type of wood continues to "grow," or change in heat, cold or humidity; once it changes shape, it stays that way. Ren Shape modeling material is not affected by humidity and it will snap back to tolerance even after exposure to extreme temperatures. This is an important advantage in modeling auto parts.



Vertin met with a European auto manufacturer to discuss models for a small car to be imported into the U.S. by 1986. Visioneering had planned to use Cativo wood for the 150 parts models needed, but the client would accept only epoxy board. The reason is that European auto makers rely on their models far longer than do their American counterparts, because new designs are introduced less frequently. Typically, a European model is used three to five years, then modified and used another three years; sometimes model lifetimes exceed 10 years. Only epoxy models retain their dimensional stability without rework over such long periods.

American auto models, not needed as long, are still made mainly of wood. But that is changing. Models are shipped around the country and often exposed to weather conditions

that cause them to swell and warp; eventually all tools and checking fixtures made from wood models may be out of tolerance, resulting in poorly-fitting production parts. Because American car builders are now demanding tighter tolerances to reduce gaps between parts, they are exploring the use of epoxy materials.

The Ren Shape material Visioneering uses is TDT-178-27, a variant of the Space Block Ren Plastics developed for the Space Shuttle. It comes in boards, like lumber, and the boards are epoxy bonded to form large blocks. Visioneering's Tom Vertin Jr. has found that the Ren Shape board takes 10 percent less time to machine and finish than does wood, and that adds up to significant labor savings. "This material is best for our industry," Vertin says. "It's a quality product."

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